

X. *Notes on insect enemies in the Tropics and their influence on mimicry.* By E. A. COCKAYNE, F.L.S., F.E.S.

[Read November 16th, 1910.]

THE influences which have caused and continue to act on mimicry in butterflies and other day-flying insects, are now recognised to be different, not only in each country, but in each case of this form of protection; and any observations at first hand which tend to throw light on them are consequently valuable. This must be my excuse for giving you the following scanty and disconnected notes and my reflections on their meaning. I have recently spent six weeks in Ceylon, three in Java, three in Celebes, and four in Japan, and though spending no time in specially looking out for cases of diurnal insects caught by their enemies, I was always on the watch for any obvious one, and noted it down at once. I will first deal with cases of insect enemies which came under my notice, then lizards and birds.

In Ceylon, Java, and Celebes dragonflies were very abundant, but, though they frequently had to turn aside to avoid a collision with a butterfly, they seemed quite indifferent to its proximity.

The only exception was at Kandy in Ceylon, where I saw a small dragonfly, perhaps a *Sympetrum*, capture a small dull brown Hesperid. The dragonfly fell to the earth still holding it, and then let it go. The "skipper" flew up and settled on a leaf, apparently unhurt, but the dragonfly made no attempt to pursue it.

Kershaw (Proc. Ent. Soc. 1905) notices a similar indifference in South China.

In Japan dragonflies were less abundant and butterflies much fewer, both in species and numbers. At Nara I saw a moderate-sized dragonfly carrying a *Mycalesis*, and at Nikko a similar one carrying a specimen of *Satyrus dryas*. I tried to catch the latter and failed, but the dragonfly dropped the butterfly, dead, but uneaten. In both cases the butterfly captured was a Satyrid, and in neither case had the wings been cut off.

Dr. Longstaff, Trans. Ent. Soc., 1905, p. 135, notes the  
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capture of *Blanida goschkevetschii*, also a Satyrid, by the dragonfly *Orthetrum japonicum*, Uhler, near Yokohama.

At Miyanoshita, in Japan, I saw a green mantis on a lily flower with a *Papilio maackii*, of which it had eaten the head and half the thorax.

At Kandy, in Ceylon, I saw a large Asilid fly carrying a bright green bug, a protected species. Mr. E. E. Green gave me its name, but I have mislaid the note.

Lizards of the genus *Calotes* are very abundant in Ceylon, especially round Colombo and in the hill districts, but becoming scarcer towards the north of the island. There are several species, of which the green ones are most fond of sitting on tall herbaceous plants or at the ends of twigs on bushes and small trees, the brown ones on tree trunks. All are good climbers and very active, but the green ones, from the nature of their resting-place, are most likely to destroy butterflies. Small-scaled brown ground lizards are also common, but if they catch butterflies, as is probable, it must be chiefly low-flying genera such as *Terias* or some of the *Lycaenidae* and *Hesperidae*.

The following are my notes:—

Colombo, March 31st, 1910. Saw a green *Calotes* lizard at the end of a twig on a high hedge of a lilac-flowered shrub, try to catch a large blue-black carpenter bee (*Xylocopa*). It missed the bee, but large numbers of the same species were visiting the flowers, and from its eagerness there is little doubt it was in the habit of eating these insects.

Nowara Eliya, 6500 ft., May 10th. Two specimens of *Euploca ascla* were fluttering round a tall Composite plant, near the flowers of which a long-tailed green lizard (*Calotes*) was sitting. The lizard snapped at one but missed, and both flew away. After a short time one returned. Before it settled the lizard jumped and fell further down the plant, but with the head and thorax of the *Euploca* in its mouth.

The butterfly opened its anal tufts, and the lizard, after remaining quiet for a minute or two, began to chew it up, getting it further and further into its mouth. I removed one wing, which I show to-night, but the whole of the rest of the butterfly was devoured, obviously with enjoyment.

The same day at Hakgala I saw two of the shorter-tailed brown lizards, each with a beetle in its mouth, but failed to catch either of them.

Colombo, June 9th. A male *Elymnias fraterna* (*undularis*) was fluttering round a female, which was at rest on a palm leaf about eight feet from the ground. There was a sudden rustle, and a green lizard (*Calotes*) ran along the leaf and snapped at them, but went just between them, and missed both. They at once flew to a higher leaf. Later the same lizard tried to catch a male *E. fraterna*, but never actually had an opportunity. The lizard climbed down the palm towards the butterfly, which was fluttering up and down, and kept altering its poise ready to make a sudden rush, but the butterfly never came quite near enough.

Finding the lizards quite near at hand, I tried to experiment with them, but unfortunately had only two days of showery weather before leaving the island, and material was scarce. I caught a fine *Papilio aristolochiae*, and, giving the fore-wing a twist near the base, offered it to the lizard at the end of a stick. It moved, and the lizard rushed forward and knocked it off the stick in its eagerness for a meal. The butterfly flew away, and I could not procure a second.

Colombo, June 10th. Caught two females of *E. fraterna*, which in this sex mimics *Danais plexippus* in its colour and slow flight in the open; the male, dark brown in colour, is much more active, but rarely ventures far from its food-plant, the palm.

I put one on a palm leaf near a lizard, where it remained still for twenty minutes before it flew off; and although it was in full view of the lizard, it was left unmolested. The second, which I treated in the same way, at once began to flutter, and the lizard eagerly dashed at it, but missed, and ran away to hide.

To another lizard (*Calotes*) I offered a specimen of *Telchinia violae*, a distasteful species, on the end of a stick. It slowly opened and closed its wings. The lizard saw it at once, and, after poisoning itself, rushed forward, caught the butterfly by the head and thorax, and rapidly ate it all, including the wings, chewing it with gusto. Later I saw a male *E. fraterna* resting in full view of and very near a lizard, but it never moved, and was left untouched.

The above observations bring out two or three interesting points. One is that so long as a butterfly remains still it is let alone, but is attacked as soon as it moves.

Hence the wounds inflicted are very unlikely to be symmetrical, but are more likely to take the form of large pieces removed from one side only—a kind of injury I often met with in *E. fraterna*. Symmetrical injuries are most probably caused by the ground lizards.

The second point is that, of the species I saw attacked, so many are either distasteful, and in some cases models for mimicry, or are mimics of distasteful species.

*Xylocopa*, a model.

*Euploca asela*, distasteful and a model.

*Telchinia violae*, a distasteful *Acracine*.

*Papilio aristolochiae*, a distasteful *Papilio* and a model for one of the forms of female of *P. polytes*.

*Elymnias fraterna*, of which the ♀ is a mimic of *D. plexippus* or *chrysippus*.

The last case is discounted by the fact that the lizards experimented on probably fed chiefly on this species, and may never have met with its models.

Though very incomplete, these observations seem to show that the green species of *Calotes* will eat any insect, even those belonging to distasteful or protected groups. And it is a great pity I could not continue these experiments on wild lizards, which, though they required a good deal of patience, were comparatively easy.

I have noticed no other records of notes on these lizards except that Kershaw (Trans. Ent. Soc. 1905, p.5) says *Calotes versicolor* destroys great numbers of butterflies at Hong Kong, as they visit *Lantana* flowers, but mentions *Hesperidae* as their chief prey, and does not give an instance of a *Danaid* or *Euploca* being attacked, though both often visit *Lantana* there.

At Miyanoshta, Japan, I saw a large black "swallow-tail," *Papilio macilentus*, caught by a small ground lizard allied to the Ceylon species.

Ground lizards (*Lacerta*, etc.) appear to be by no means indiscriminate in their choice of food.

Poulton ("Colours of Animals"), Marshall (Trans. Ent. Soc. 1902, pp. 339, 435), Rosenberg (Proc. Ent. Soc. 1909, pp. lx-lxii) says that in S. America they eat many butterflies, *Callidryas*, *Nymphalinae*, and *Papilio*, but mentions no distasteful species.

Thus *Lacerta* and other ground lizards may influence mimicry favourably in some countries, though Marshall thinks it has little influence in S. Africa, while *Calotes*

probably influences it unfavourably by destroying protected species or their mimics, which, owing to their slow flight, may fall victims in numbers out of proportion to those of the swifter unprotected species.

In birds I saw little positive evidence that they prey on butterflies, but it was quite obvious they were unwilling to chase butterflies flying actively in the sunshine. I often saw one almost touch the head of a drongo and yet never saw one attacked.

On March 31st, at Colombo, I saw a Syntomid, one of a family usually considered distasteful, caught on the wing and eaten by a sparrow; and on April 12th at Haragáma, Ceylon, a sparrow chased an *Appias paulina*, but soon gave up.

On June 10th, at Colombo, a magpie-robin ate a female *Elymnias fraterna*, which I had been offering to a lizard, and which fluttered on to the ground. Its resemblance to *D. chrysippus*, or *plecippus*, did not save it. The evidence of birds attacking butterflies collected by Marshall and others is too strong to be disregarded, and one cannot help thinking they are a very strong influence at work in causing and improving many of the wonderful examples of mimicry now so well known.